Design on Computer–A Coming of Age

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One key purpose of computer simulation is to focus and limit the number of laboratory experiments needed in the design process. Whether building a multi-million dollar jet fighter or a dipole array, an accurate model that predicts key performance parameters is considered essential for reducing cost and meeting design specifications. The software should ideally provide high fidelity, near real-time simulation results, as well as an interface to the design engineer that is relatively simple and is tailored to the problem space being considered. This software will encompass the physical and engineering properties of the device or system being built, the mathematical methods appropriate for analysis, sophisticated algorithm developments, exploitation of the computer architecture being used, and appropriate visualization and graphical interfaces. The software is also ideally priced to sell, easy to maintain and has a minimal learning curve for users.

Though we are clearly far from reaching these goals, electromagnetic design on computer has evolved rapidly over the last three decades and continues to advance in a range of areas. Not ten years ago, there were only a handful of commercial simulation codes available, and these dominantly used text input and output, with the designer sometimes painstakingly entering the antenna, scatterer or waveguide geometry. Many times the software was incomplete, requiring external libraries for special functions or linear system solution. Similarly, the number of textbooks in the area of computational electromagnetics was small, consisting mainly of specialized books for specific applications or algorithms. Currently, the number of commercial self-contained simulation software suites is growing both in breadth and sophistication with different vendors even competing in well-defined component design areas. And in the bookstore, the number of relevant textbooks has greatly multiplied with most having the described software freely available.

This talk will examine the state-of-the-art in computational electromagnetics, grouping the field into advances in 1) components or system design and related electromagnetic algorithms, 2) available computer hardware and architecture and 3) integrated design environments including optimization methods. Initially an evaluation of each area will be presented with specific items that require further research and development following. The application to antenna design, microdevice analysis, multi-disciplinary design and optimization as well as other areas will be presented.